Achieving the Difficult Challenges

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2002 Conference on
Unburned Carbon on Utility Fly Ash

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The Future is Already Here...

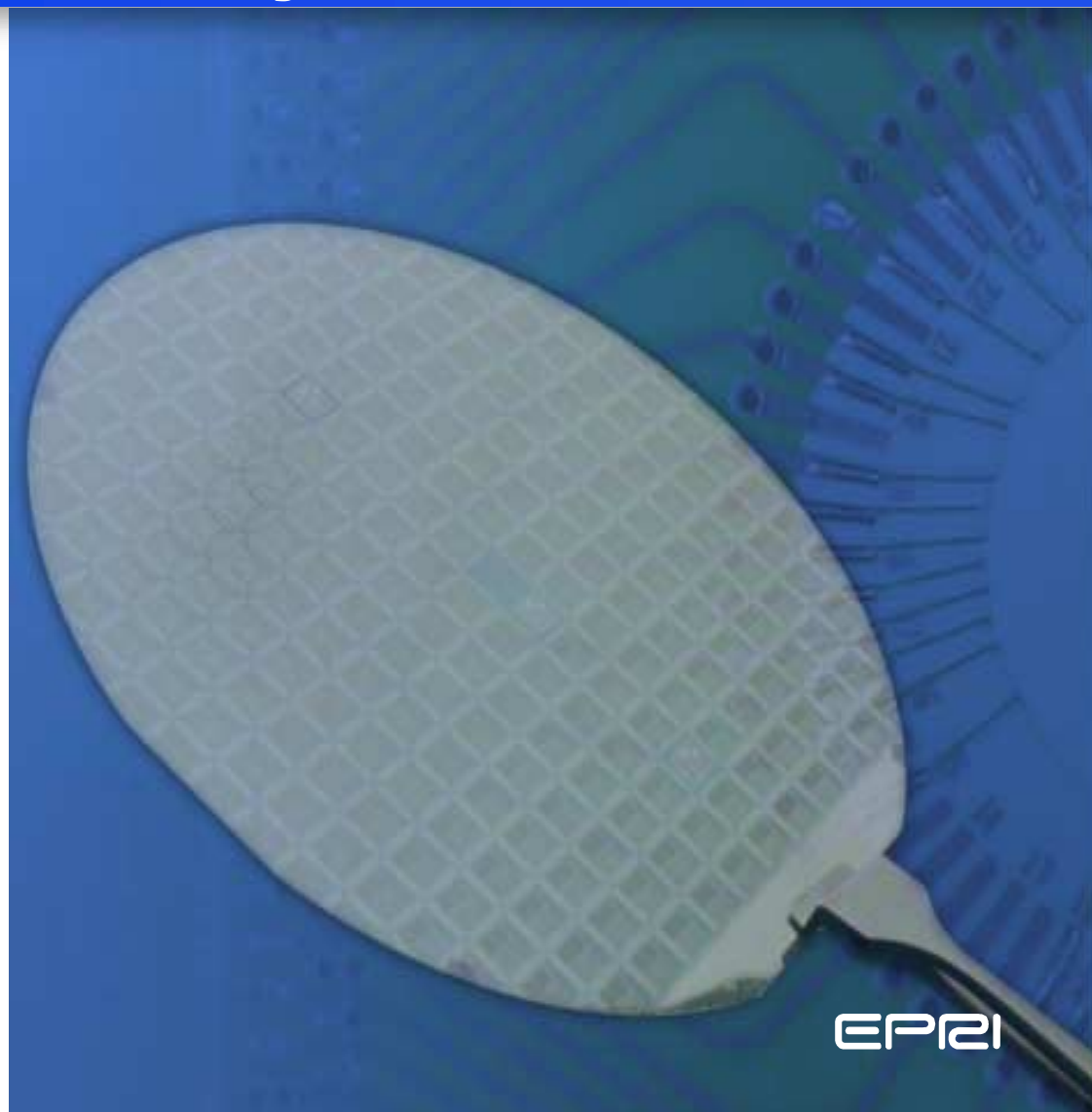
...and opportunities can come from places we are least likely to expect

A simple tool designed for easy phone installation becomes the universal gateway to the internet

There Are Technology Breakthroughs Everywhere!

- Fiber Optics / Wireless Communications
- “Chips” providing Smart Electron products
- Nanotechnology
- Biotechnology

And there will be more . . .

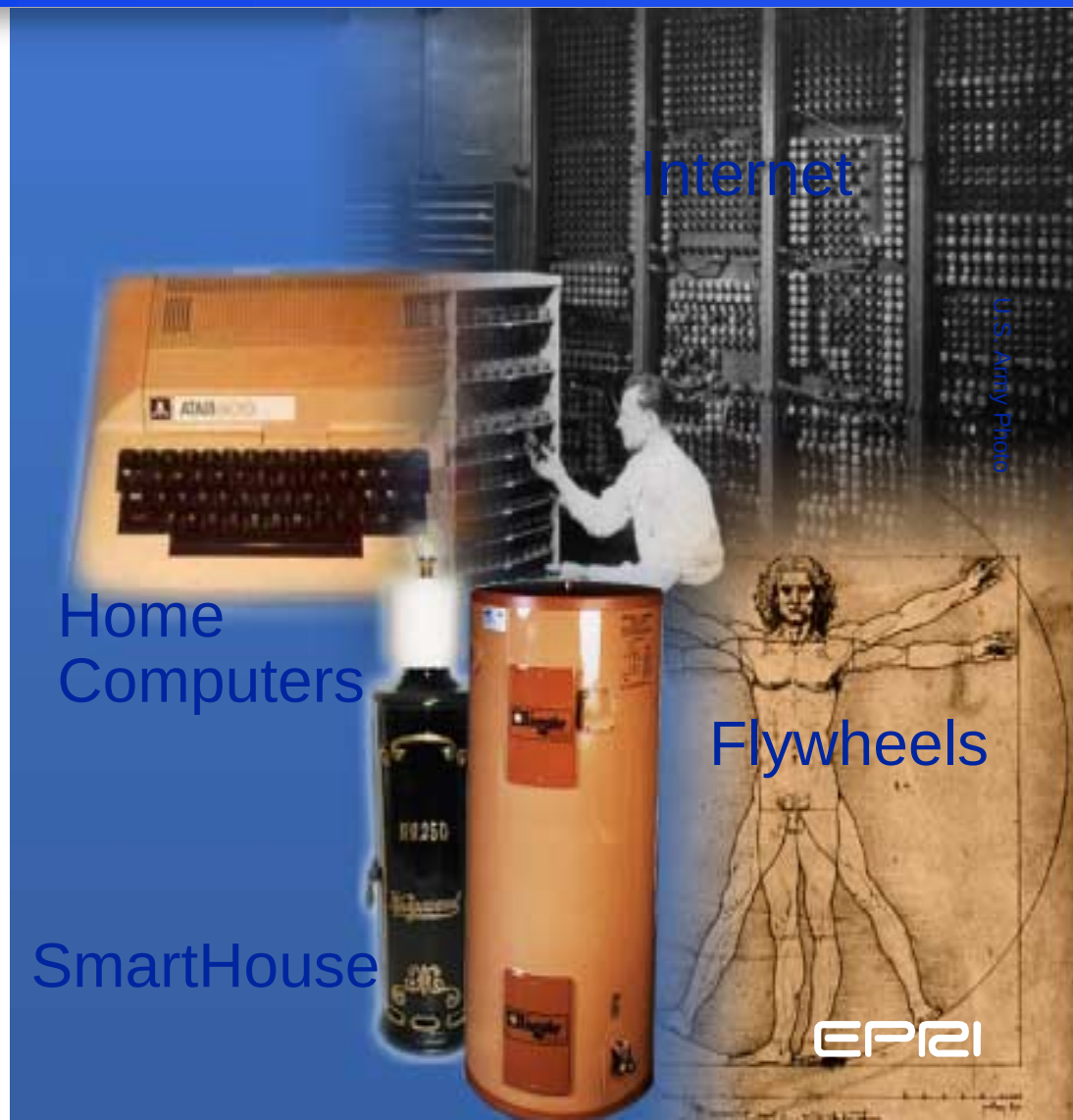


Opportunities and Threats

New Products …including "disruptive" technologies

Markets and Policy which are misaligned

Uncertainties in fuel prices and availability



Shaping the Future

Electricity and Economic Prosperity

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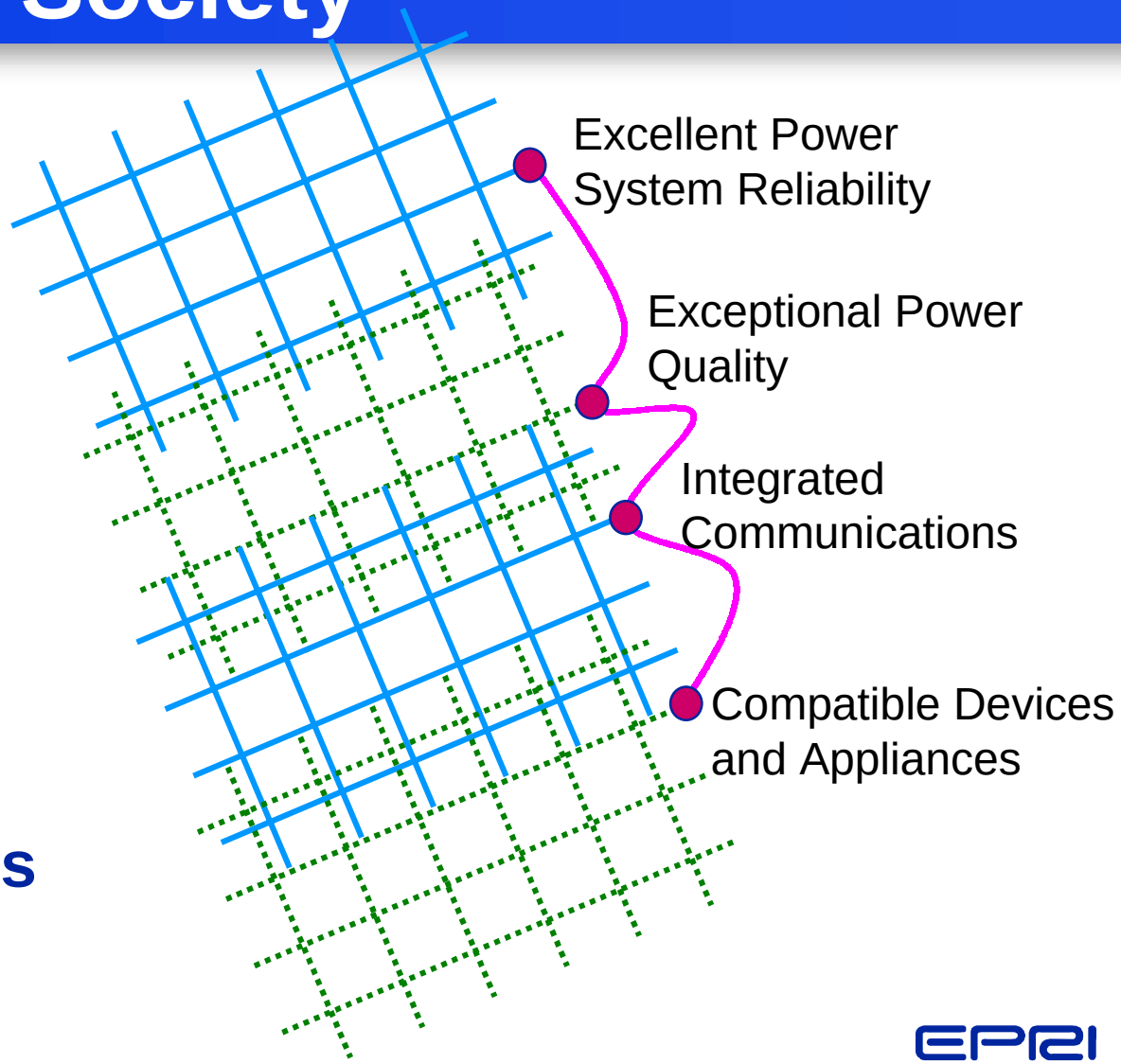
The Infrastructure for a Digital Society



A Complex Set of Interconnected Webs create opportunities and present challenges

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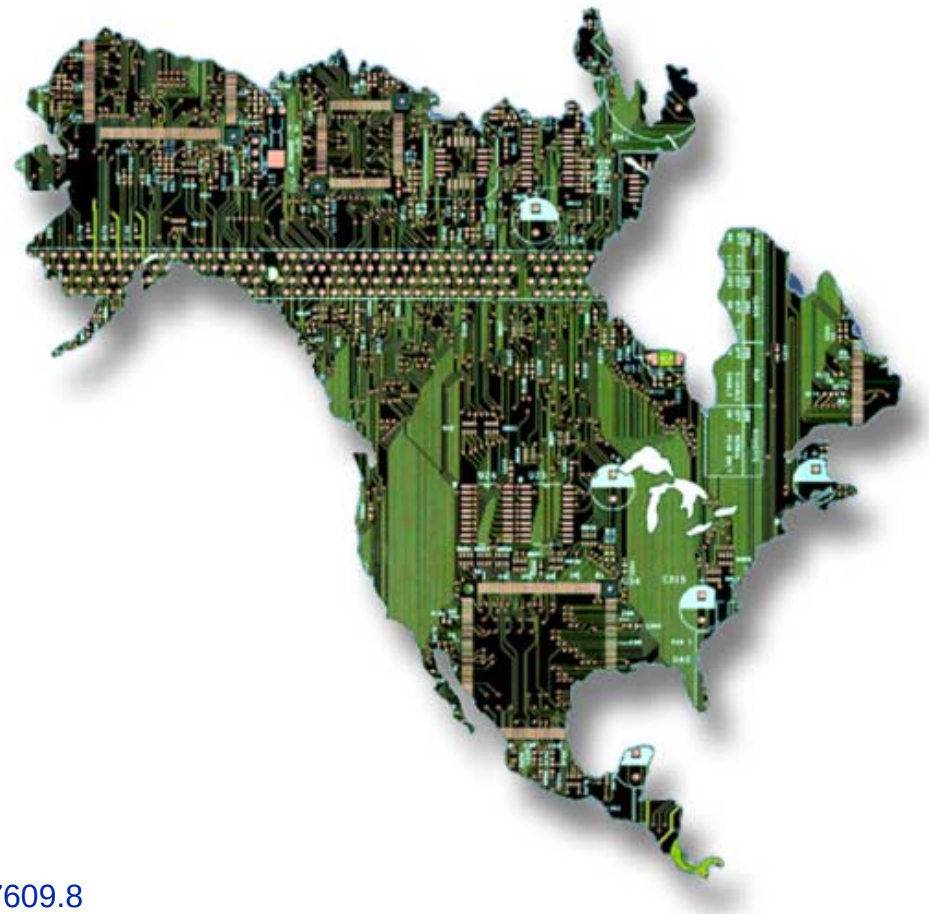
Power Delivery Infrastructure Of Tomorrow

The Expanding Grid



- An electronically controlled, smart electricity network
- Transcontinental transmission of power and services
- Super-conducting cables reduce losses
- Security monitoring and response capabilities

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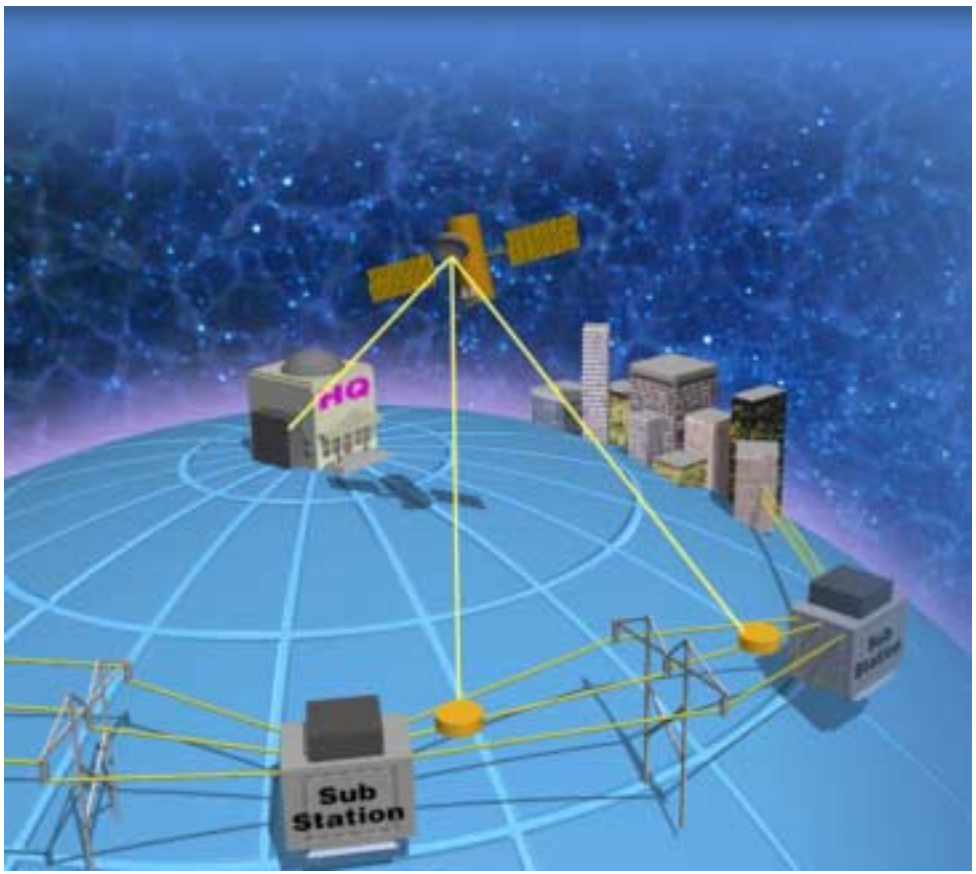
The Self-Healing, Digital Quality Electricity Superhighway



Self-Healing Grid

Post-Silicon Power Electronics

Robust Generation Portfolio

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Energy/Carbon and Global Sustainability

Limit-Breaking Technologies

- Clean coal technologies
- Carbon sequestration
- Advanced nuclear power
- Distributed renewable power systems
- Electricity/hydrogen

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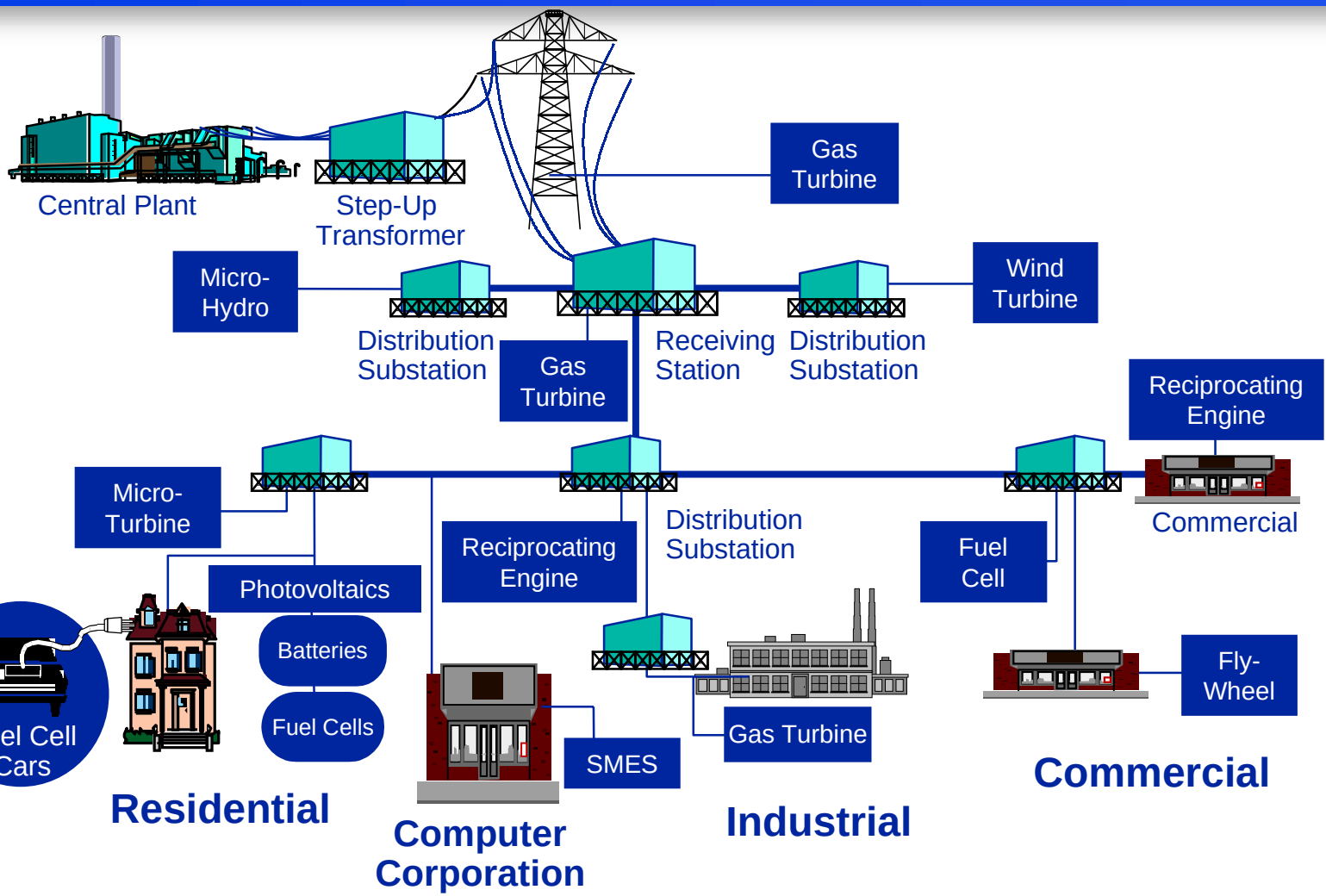
Integration of Distributed Power

Generation/ Transmission
- Capacity support
- Remove bottlenecks
- Voltage support

Distribution
- Voltage support
- Power Quality
- Reliability

Customer
- Back-Up
- Premium power
- Power Quality
- Internet loads
- Minimize blackouts



Renewable Energy Maximization

Integration with the Grid

Integration with Building Components

Energy Storage for Maximizing Market Value

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CO2 Capture and Sequestration

- There exists a critical capabilities gap in our knowledge of cost-effective CO_2 capture and sequestration options
- This is a key issue that may define the use of coal in the long term

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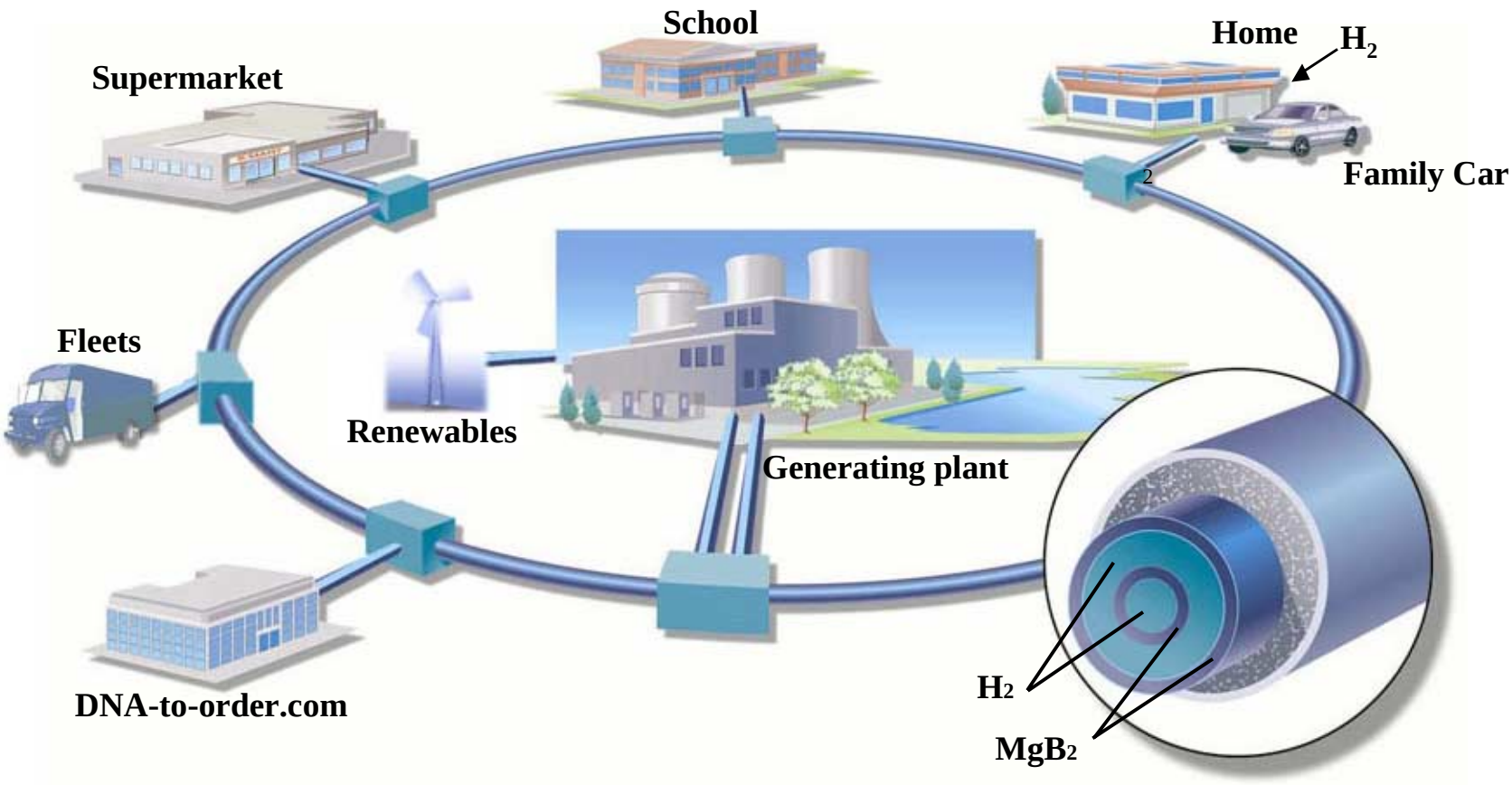
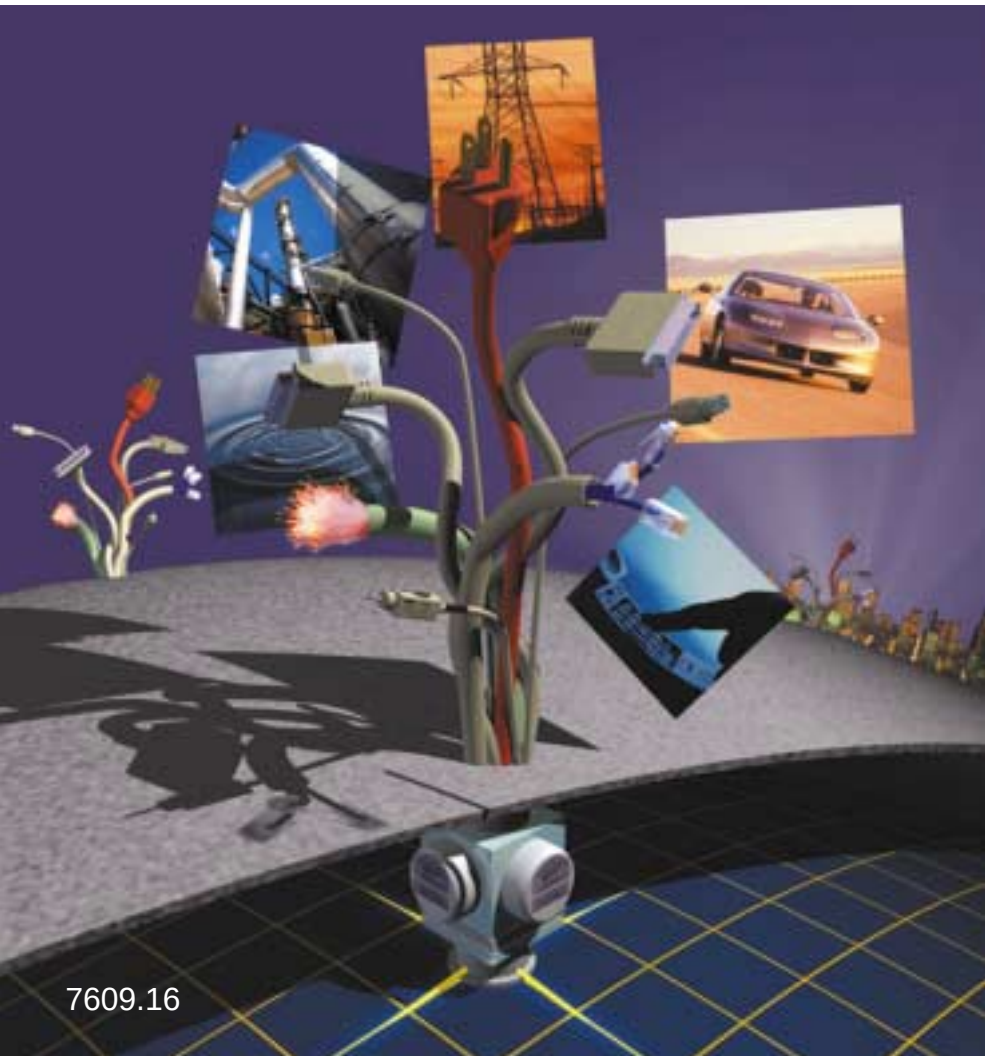
Hydrogen and Fuel Cells … R&D Challenge -- H_2 Infrastructures



Customer-Managed Service Networks



- Mega infrastructure of electricity and communications
- New “intellectric” services
- Premium power for a digital society
- Transportation integrated with power delivery

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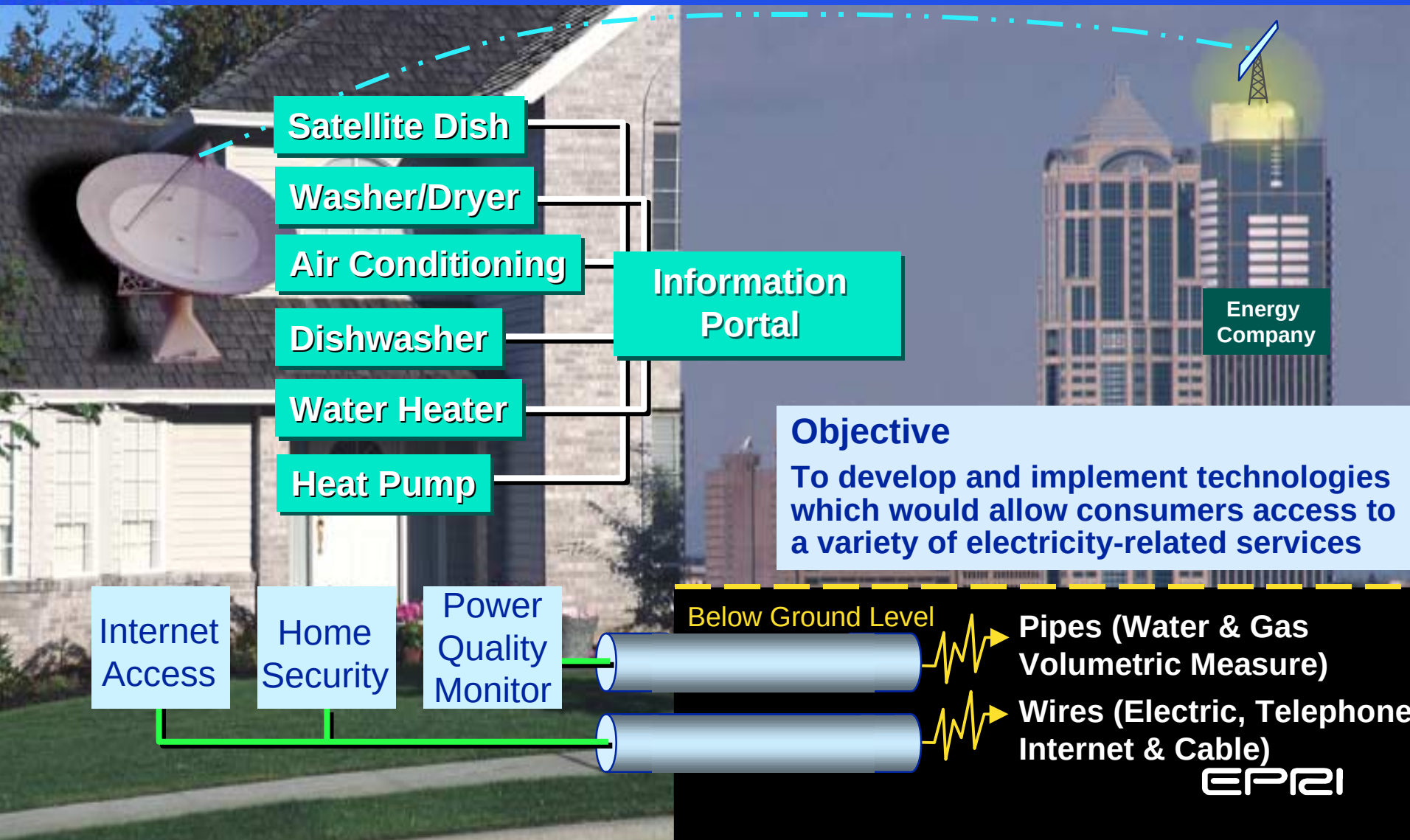
Value-Added Electricity Services Opportunities

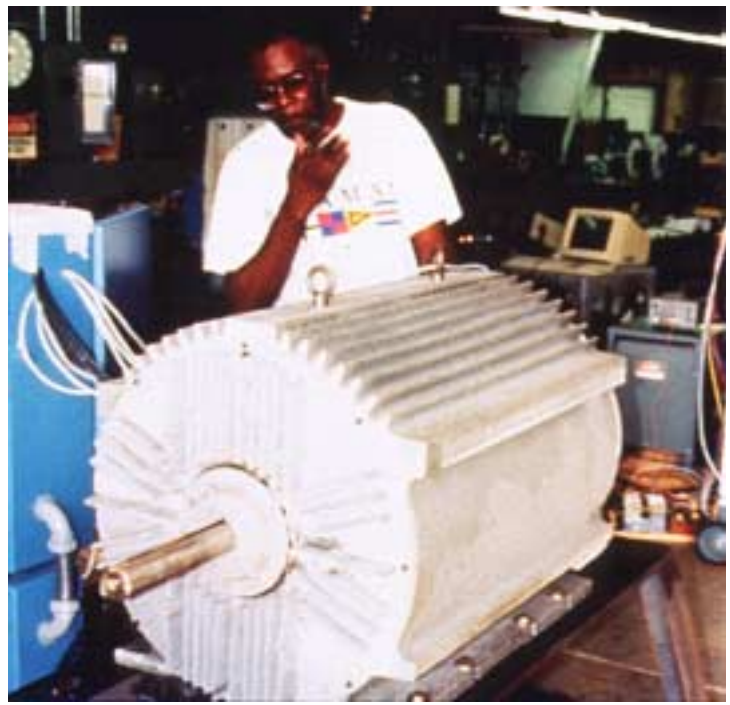


Objective

To develop and implement technologies which would allow consumers access to a variety of electricity-related services

Enable Greater Energy Efficiency

Load Management Technology



New End-Use Devices

Infrastructure Does Make a Difference

‘Transformed’ vs. ‘business as usual’ –

What are the benefits?

- 35% greater productivity growth
- 20% higher GDP growth
- 30% lower energy intensity (kWh/$GDP)
- 35% less carbon emissions

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Electricity and Global Development

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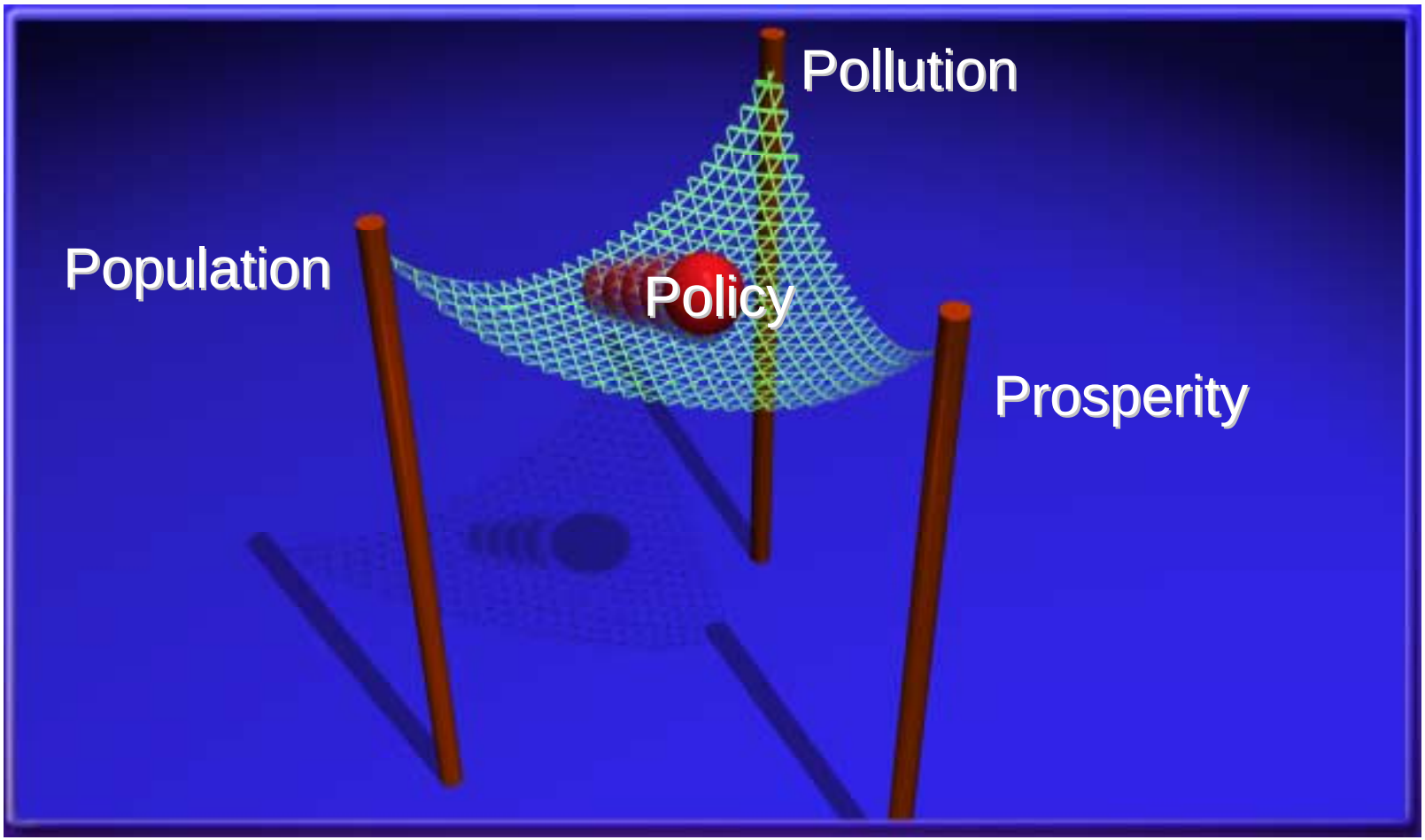
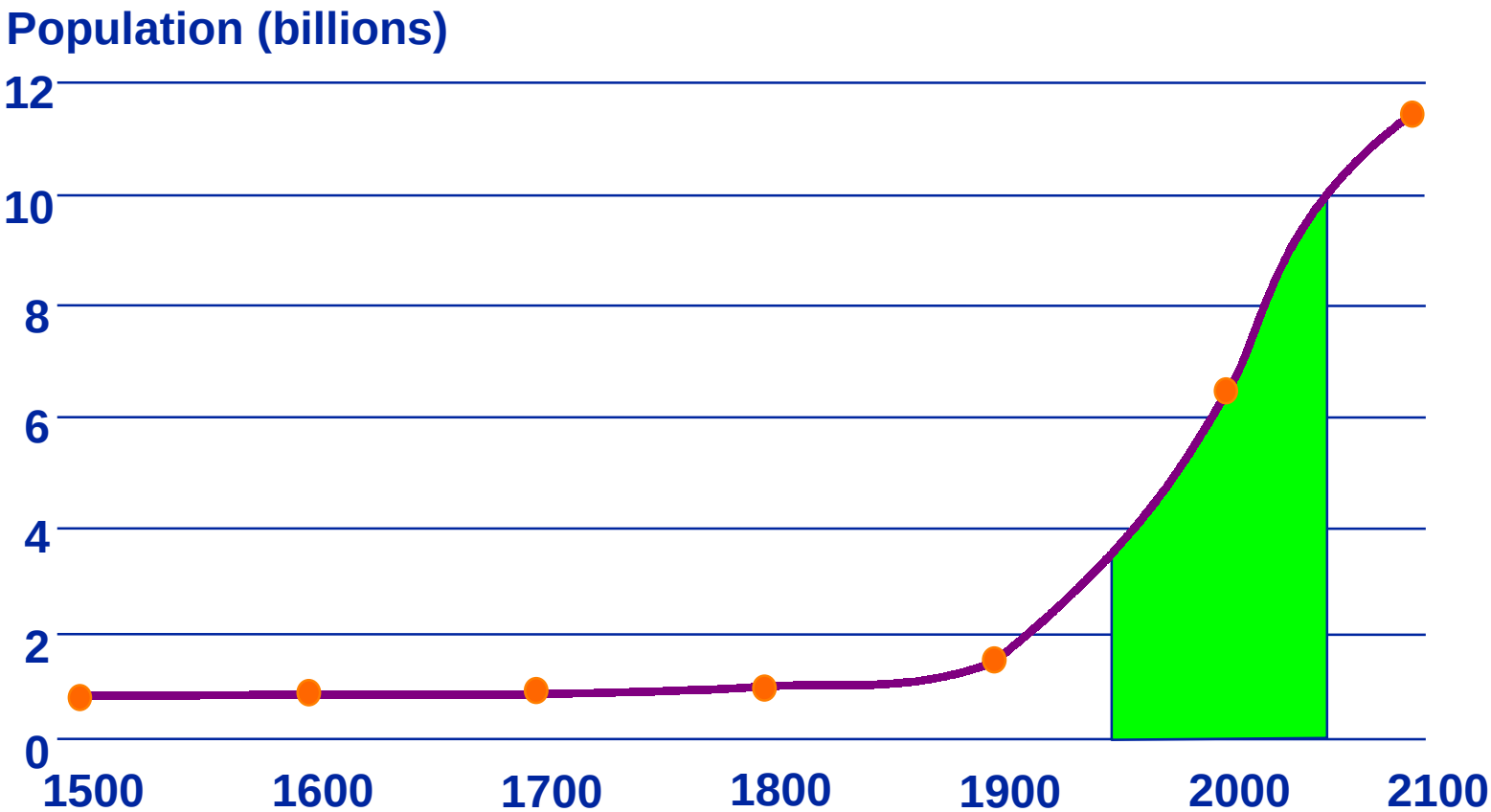
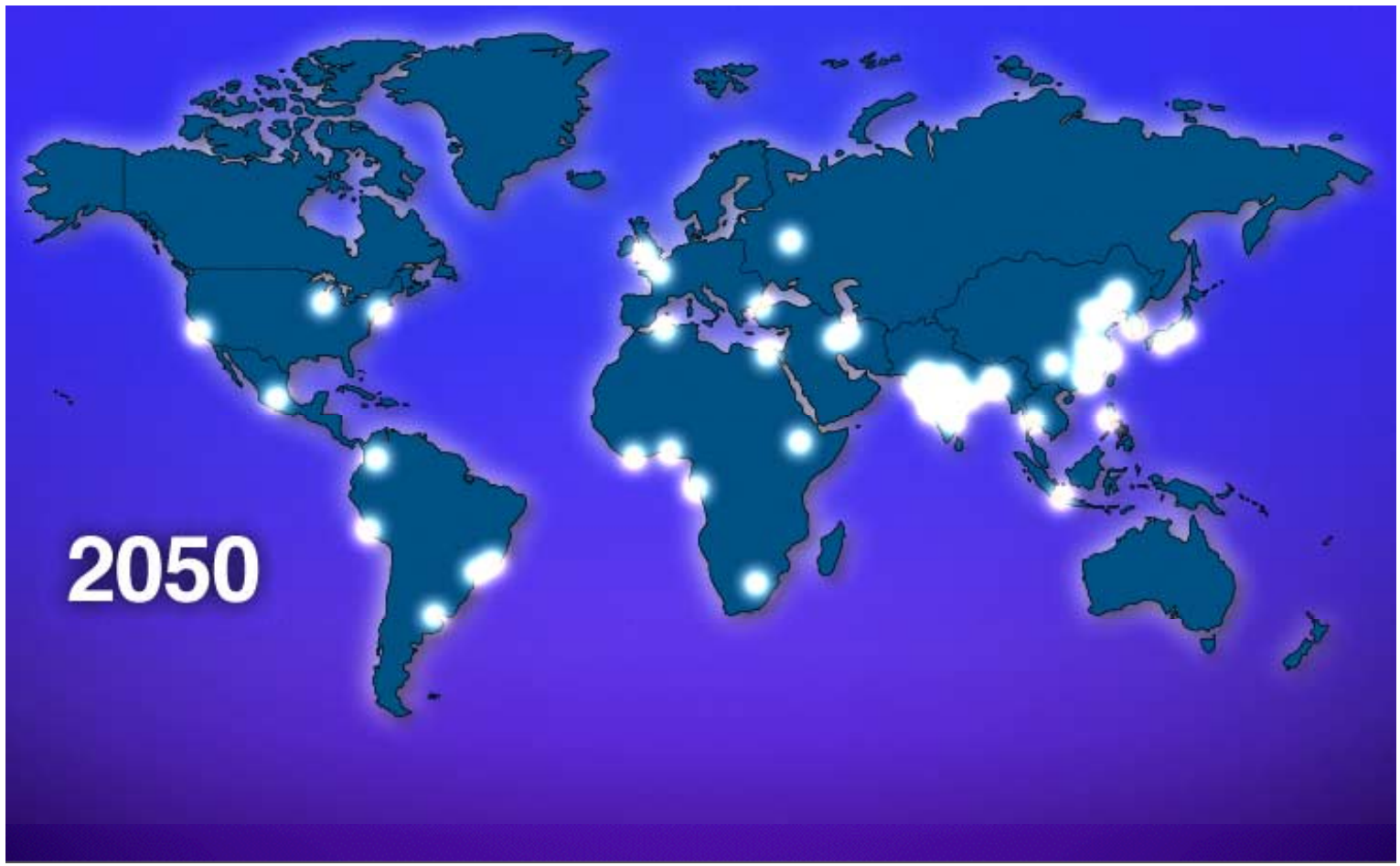
Energy Policy Trilemma



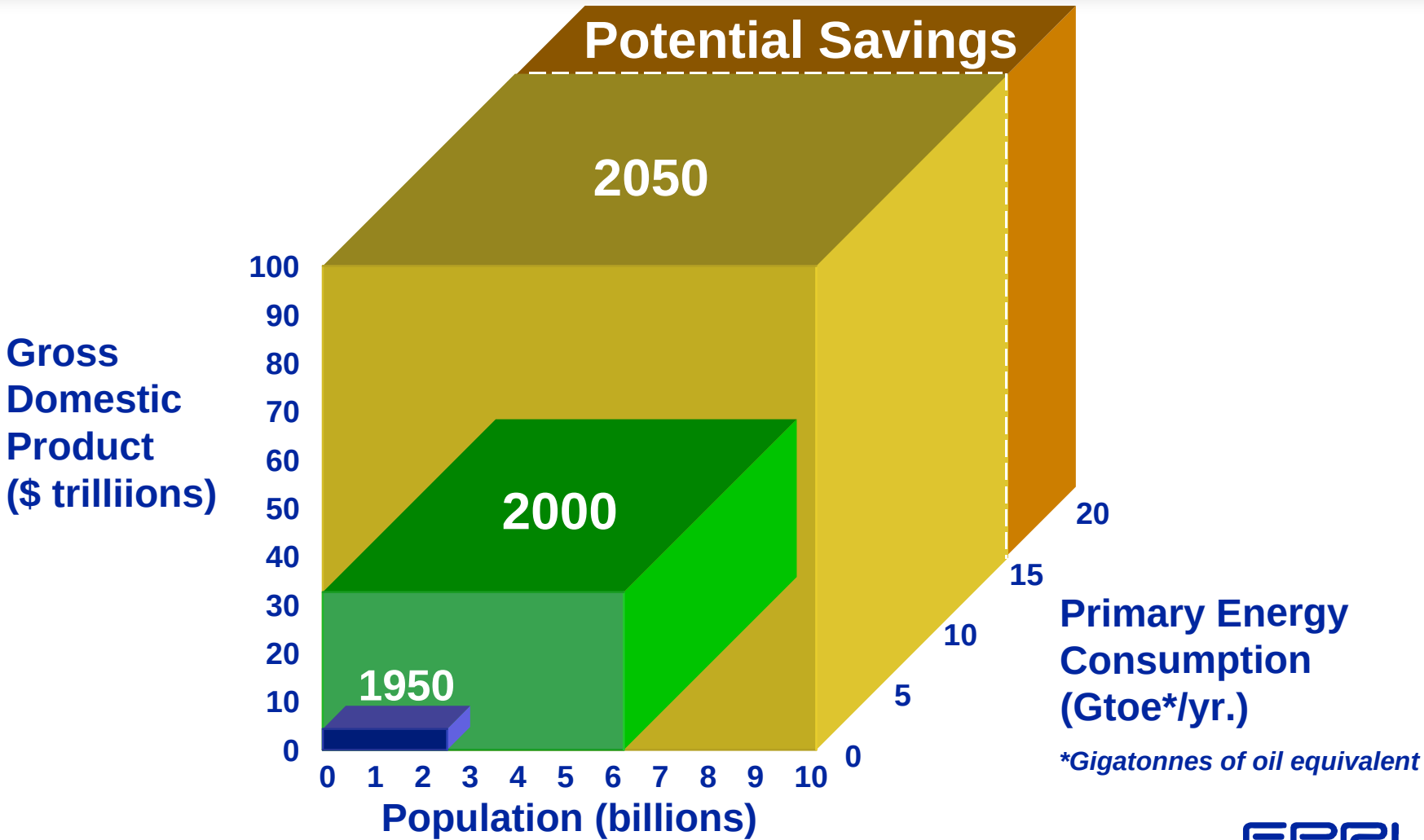
The World Population Explosion



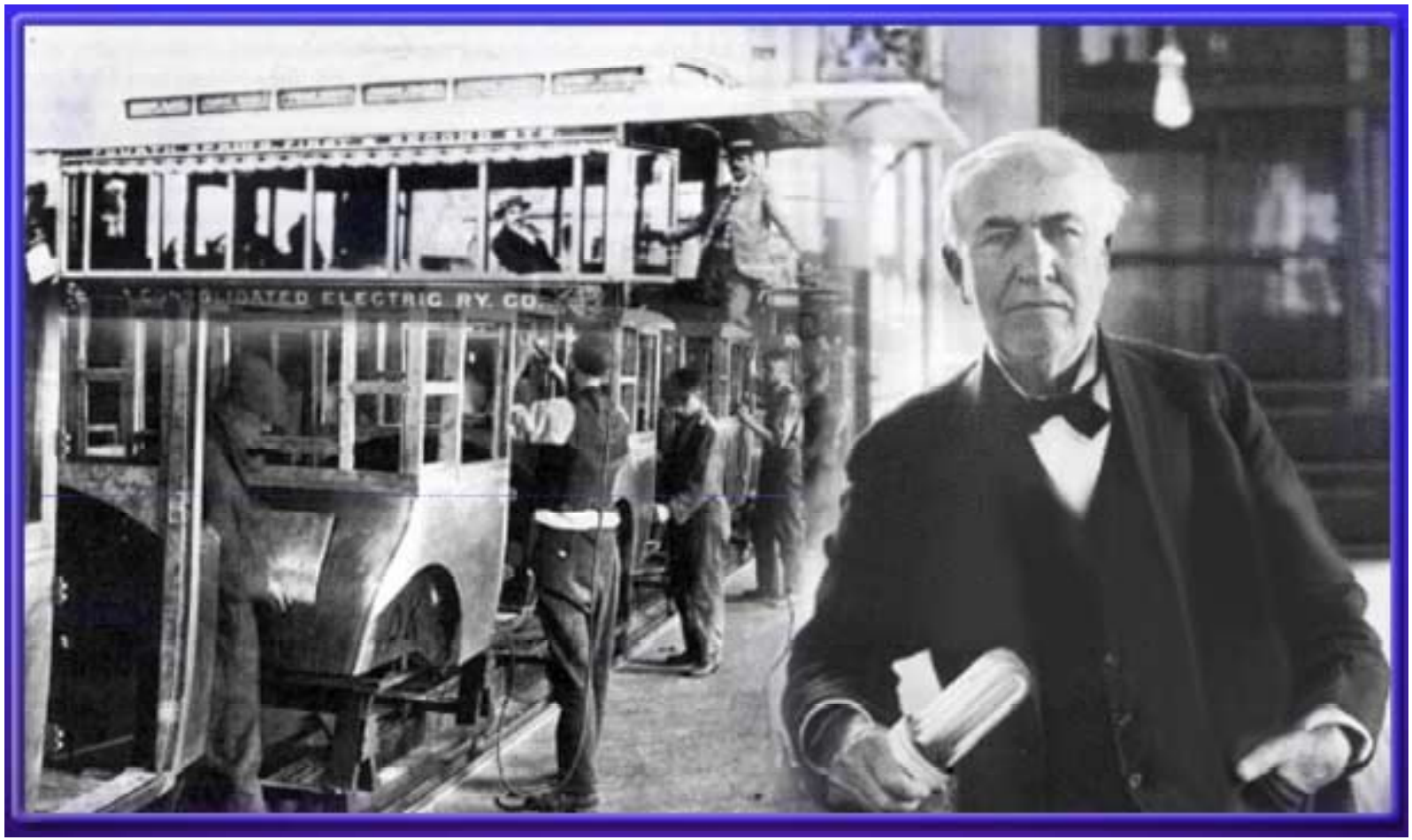
Megacities



Mankind's Footprint, 1950-2050



Innovations for a Better Way of Life



To Visualize Beyond the Obvious… … Or Not

New, disruptive technologies are often underestimated…

"The wireless music box has no imaginable commercial value. Who would pay for a message sent to nobody in particular?"

Advice to David Sarnoff on investing in the radio 1920's

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The Future is Already Here...

Imagine the Possibilities

- Scan and understand markets
- Act, initiate and try new technologies
- Develop new options
- Build alliances, partnerships
- Prepare for disruptive market forces

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“The best thing about the future is that it only comes one day at a time.”
– Abraham Lincoln
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